

# OPERATING INSTRUCTIONS

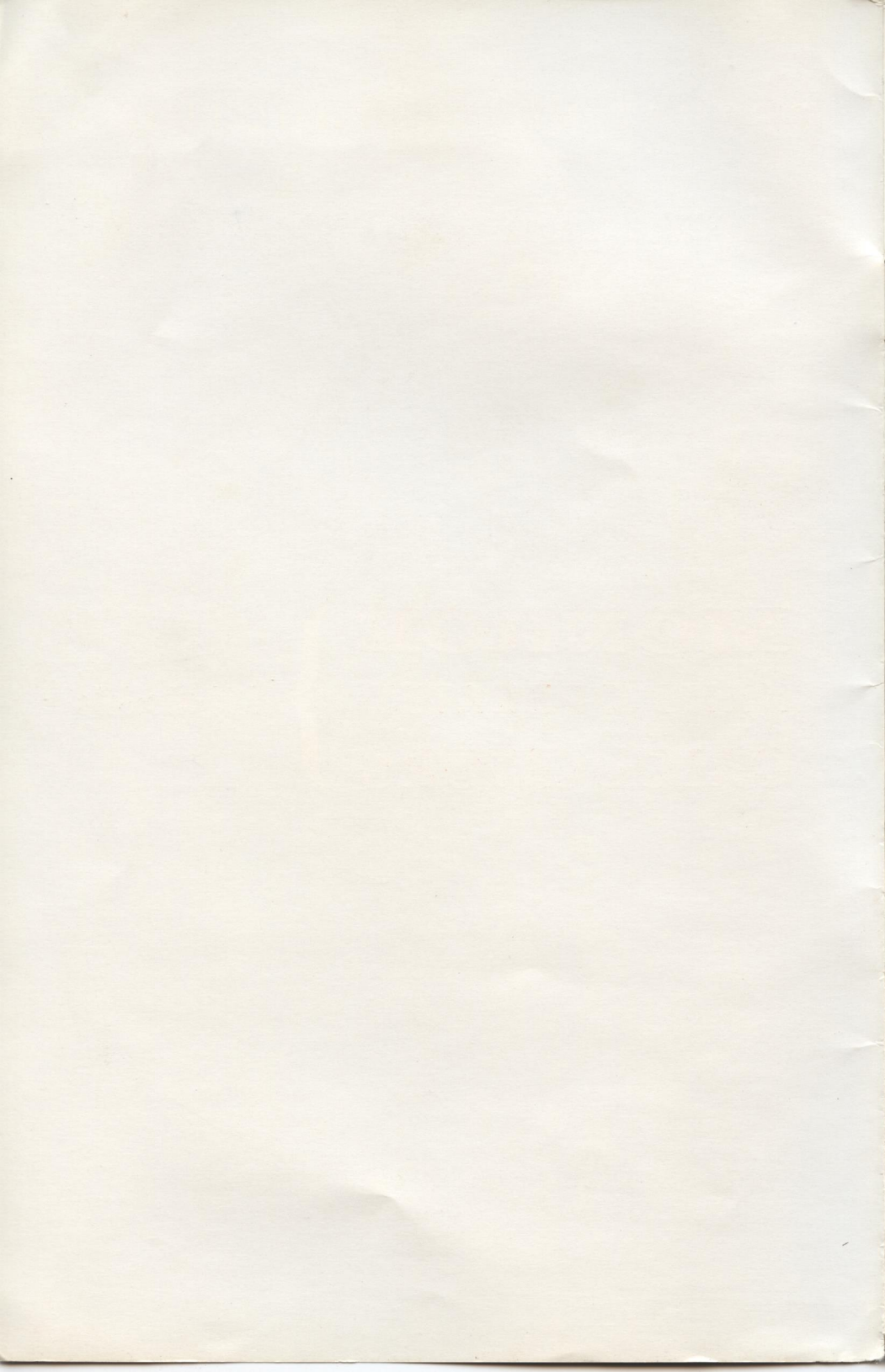
**MONROE**

HAND OPERATED

**CALCULATORS**



LN Models



# **OPERATING INSTRUCTIONS**

## **MONROE CALCULATING MACHINE**

Hand Operated LN Models

**MONROE CALCULATING MACHINE COMPANY, INC.**  
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## FOREWORD

**T**HIS BOOKLET describes the operating controls and parts of the Monroe Model LN Calculator and gives step by step instructions on the four basic arithmetic functions; addition, subtraction, multiplication and division.

The directions apply to both the 8 and 10 bank LN type Monroe hand operated machines. The former model has an eight column keyboard, eight places in the upper dials, and sixteen places in the lower or result dials. The latter, Model LN 200, is equipped with a ten column keyboard, ten places in the upper dials, and twenty places in the lower dials. The actual operation of these two models is exactly the same; the only difference is in their figuring capacities.

CONTENTS  
FOREWORD

The first section of the report is devoted to a general survey of the work done during the year. It includes a summary of the results of the various investigations and a statement of the progress made in the different branches of the work.

The second section of the report is devoted to a detailed account of the work done during the year. It includes a description of the various experiments and a statement of the results obtained. It also includes a discussion of the various problems which have arisen during the course of the work and a statement of the methods used to solve them.

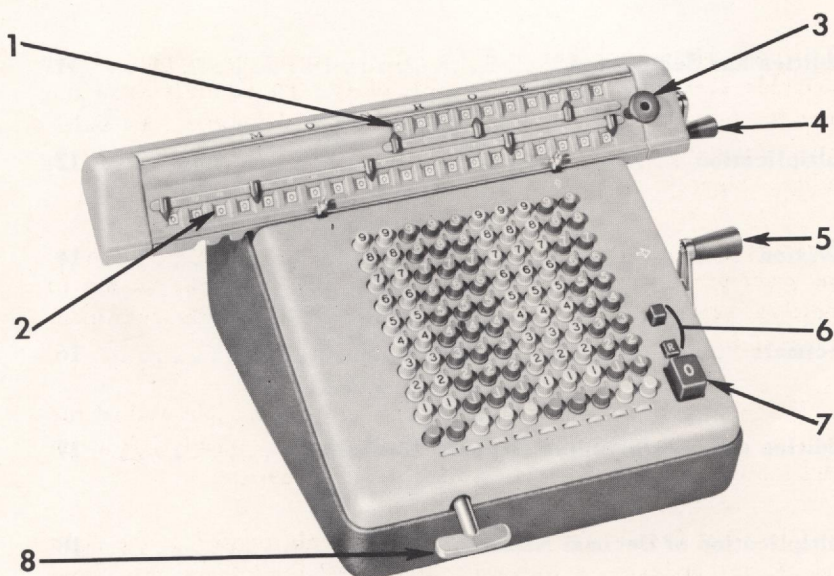
The third section of the report is devoted to a summary of the results of the work done during the year. It includes a statement of the main conclusions reached and a statement of the work which remains to be done.

The fourth section of the report is devoted to a list of references. It includes a list of the books and papers which have been consulted during the course of the work.

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# MONROE CALCULATOR Model LN



## Operating Controls

- |                        |                               |
|------------------------|-------------------------------|
| 1. Upper Dials         | 5. Operating Crank            |
| 2. Lower Dials         | 6. Repeat and Non Repeat Keys |
| 3. Carriage Shift Knob | 7. Keyboard Clear Key         |
| 4. Clear-out Crank     | 8. Carriage Shift Lever       |



# MONROE MODEL LN

## Description of Operating Controls and Parts

1) **Upper Dials** The set of dials located in the upper part of the moveable carriage is called the upper dials. These dials show the quotient (answer) of a division problem in red figures. In multiplication, they show the multiplier (number by which you multiply) in black figures.

2) **Lower Dials** These are the sixteen (or twenty) dials located in the lower part of the carriage. The lower dials show the answer in addition, subtraction, and multiplication. They show the remainder in division.

3) **Carriage Shift Knob** This knob, located at the right end of the carriage, is for shifting several places at a time. Simply lift up on the knob and slide the carriage to the desired position.

4) **Clear-out Crank** This is the smaller crank located at the right end of the carriage. A forward (clockwise) turn clears the upper dials, and a backward (counter-clockwise) turn clears the lower dials.

5) **Operating Crank** The operating crank is the larger crank located on the right side of the machine. This crank is used in all operations on the machine. The operator should clearly understand what is meant by a forward turn and a backward turn of this crank in order to follow the instructions in this booklet.

**6) Repeat and Non-repeat Keys** When the repeat key (key marked "R") is depressed, any figures set on the keyboard remain down until cleared by the operator. When the non-repeat key (key above repeat key) is depressed, the keyboard clears after each turn of the operating crank. The repeat key *must* be depressed when performing multiplication and division.

**7) Keyboard Clear Key** The keyboard keys are cleared in one of two ways, either by depressing the large square zero clear button, which clears the entire keyboard; or by depressing the individual "zero" clear keys at the bottom of each column, which clear keys one at a time.

**8) Carriage Shift Lever** By a half turn of this lever, located at the left front of the machine, the carriage may be shifted to the right or left as desired. The operating crank must be in upright, or "neutral" position when shifting.

### TO CLEAR THE MONROE MODEL LN

The operator should always remember to clear the entire machine before starting any new work. Complete machine clearance is a simple procedure which can be done almost subconsciously.

To clear keyboard — Depress Keyboard Clear Key

To clear upper dials — Make a complete forward turn of  
Clear-out Crank

To clear lower dials — Make a complete backward turn of  
Clear-out Crank

NOTE: The operating crank *must* be in upright, or "neutral" position when clearing.

## ADDITION AND SUBTRACTION

Addition and subtraction can be accomplished with the carriage in any position but it is suggested that the carriage be placed in position "1", that is, as far to the left as possible.

The most rapid and efficient way to add and subtract is with the non-repeat key depressed so the numbers automatically clear from the keyboard.

### TO ADD

Depress Non-repeat key. Clear machine.

Set on keyboard	12	Make one forward turn of Operating Crank
Set on keyboard	23	Make one forward turn of Operating Crank
Set on keyboard	<u>34</u>	Make one forward turn of Operating Crank
In lower dials	69	Total

### TO SUBTRACT

Non-repeat key depressed. Clear machine.

Set on keyboard	45	Make one forward turn of Operating Crank
Set on keyboard	<u>15</u>	Make one backward turn of Operating Crank
In lower dials	30	Answer

**Repeat key addition and subtraction** Addition and subtraction can be done exactly as above with the repeat key depressed. When this is done, the number added or subtracted remains on the keyboard after the turn of the operating crank. This saves time when adding and subtracting numbers which have one or more digits the same. Try it with the following example:

Depress Repeat key. Clear machine.

Set on keyboard	47	Make a forward turn of Operating Crank
Change keyboard to read	43	Make a forward turn of Operating Crank
Change keyboard to read	-40	Make a backward turn of Operating Crank
In lower dials	<u>50</u>	Answer



## MULTIPLICATION

Multiplication is a series of additions and is a simple process on the Monroe Model LN. It is accomplished by setting one figure (usually the larger) on the keyboard and "writing" the other figure in the upper dials with the operating crank. The repeat key must be depressed when doing multiplication.

**Example:**  $12 \times 12 = 144$

**Method:** Repeat key depressed. Clear machine.

*Step 1.* With the carriage in position "1", set 12 on the extreme right of the keyboard. Turn the Operating Crank forward 2 turns. Note \*

*Step 2.* With the Carriage Shift Lever, shift the carriage one place to the right. Turn the operating Crank forward one turn.

<b>Result:</b> Upper dials	12
Keyboard	12
Lower dials	144 (answer)

This gives a complete and positive check of accuracy. If the correct numbers show in the upper dials and keyboard, the answer cannot be incorrect.

• If too large a number is turned into one of the upper dials, it can easily be corrected. Simply position the carriage so the carriage position arrow points to the incorrect dial and turn the operating crank backward until the correct number appears. If the incorrect number is too small, turn the crank forward until it is correct.

## CONSTANT MULTIPLIER

The above explanation of correcting the upper dials naturally leads to the problem where we have to multiply the same number by several different numbers.



In the previous example, we multiplied  $12 \times 12$ . Suppose we also had to multiply 12 by 31, and 12 by 15. After completing the first multiplication, the machine reads as follows: upper dials, 12; keyboard, 12; lower dials, 144.

It is not necessary to clear the machine. Leave the 12 on the keyboard and simply change the upper dials to the next multiplier.

**Example:**  $12 \times 31 = 372$   
 $12 \times 15 = 180$

**Method:** Machine reads as stated above.

*Step 1.* Clear nothing. Change the 1 in the upper dials to 3 with two forward turns of the Operating Crank.

*Step 2.* Shift carriage one place to the right. Change 2 in the upper dials to 1 with one backward turn of Operating Crank.

<b>Result:</b> Upper dials	31
Keyboard	12
Lower dials	372 (answer)

*Step 3.* In a similar manner, change the upper dials to 15 and we have:

<b>Result:</b> Upper dials	15
Keyboard	12
Lower dials	180 (answer)

This entire operation is extremely simple. It requires no expert knowledge, skill or training, and you know your result is absolutely accurate because all the figures used are visible in the machine.

It can be seen from the above that multiplication can be done in either direction. As long as the figures on the keyboard and in the upper dials are correct, the result in the lower dials will be correct.

## DIVISION

Division is just as easy and simple as multiplication. As multiplication is a process of repeated additions, accomplished by forward turns of the operating crank, so division is a process of continued subtractions, and is accomplished by backward turns of the operating crank. The repeat key must be depressed when doing division.

**Example:**  $1728 \div 12 = 144$

**Method:** Repeat key depressed. Clear machine.

*Step 1.* With the carriage in position "1", set the dividend, 1728, on the extreme right of the keyboard. Make one forward turn of the Operating Crank. Depress the Keyboard Clear Key and turn Clear-out Crank clockwise. (This clears the keyboard and clears the "1" out of the upper dials.)

*Step 2.* Set the divisor, 12, on the right of the keyboard and move the carriage two spaces to the right so that the divisor, 12, is in direct alignment with 17, the first two figures of the dividend in the lower dials.

**NOTE:** In division problems, the left hand figure of the divisor on the keyboard must *always* be either directly under the left hand figure of the dividend in the lower dials, or beyond it to the left.

*Step 3.* Turn the Operating Crank backward until the bell rings. Turn the Crank forward one turn. (The red 1 in the upper dials is the first digit of the answer.) Shift the carriage one place to the left. Turn the Crank backward until the bell rings. Turn the Crank forward one turn (bell also rings on the one forward turn to warn you not to go any farther).

*Step 4.* Continue this operation of shifting the carriage one place to the left, turning the Crank back until the bell rings and turning the Crank forward one turn.

<b>Result:</b> Lower dials	0 (remainder)
Upper dials	144 (answer)

If the operator is turning the crank backward rapidly and goes a turn or two past the bell, he should simply turn the crank forward until the bell rings, and stop. Listening for these bells makes it possible to perform the division without watching the machine.

### PRACTICE PROBLEMS

1.  $510 \div 15 = 34$
2.  $1400 \div 25 = 56$
3.  $2432 \div 32 = 76$
4.  $1659 \div 237 = 7$
5.  $1464 \div 122 = 12$
6.  $4830 \div 14 = 345$
7.  $928 \div 232 = 4$
8.  $1160 \div 145 = 8$
9.  $1274 \div 98 = 13$
10.  $510 \div 85 = 6$

Note: Be sure to clear the "1" from the upper dials and line up the lower dial figure and keyboard figure.



## DECIMALS

On all calculating machines, fractions are expressed as decimals. For example,  $1/4 = .25$ ,  $5/8 = .625$ , etc.

The arrangement of the dials and the keyboard on the Monroe makes it particularly adaptable to handling calculations involving decimal numbers.

On the Monroe, all decimals can be set for a complete group of problems before starting the work, and all the calculations can be completed without any resetting of the decimals. The work is done entirely around pre-set, fixed decimals. The one simple rule for setting decimals on the Monroe is:

Keyboard decimal + upper dial decimal = lower dial decimal

**Decimal Markers** The keyboard decimal is marked by turning one of the small knurled wheels below the keyboard to the right so that the yellow decimal marker appears between the proper keyboard columns.

The upper and lower dials decimals are marked by the gray pointers which can be easily positioned to point off the decimal exactly as with paper and pencil. To set a decimal at 2 in the dials, simply set the marker to the left of the 2 on the slide.



## ADDITION AND SUBTRACTION OF DECIMAL NUMBERS

To pre-set the decimals for a group of problems involving addition and subtraction, examine the numbers in all the problems and determine which has the largest number of decimal places. Set the keyboard decimal marker to accommodate this number of decimal places. Set the lower dials decimal at the same number. The upper dials decimal is at zero (0) and therefore the Monroe rule, as stated above holds.

Following these instructions, what is the correct decimal setting for the following problems?

$$\begin{array}{r} 12.25 \\ 3.333 \\ 10.2 \\ \hline 25.783 \end{array} \qquad \begin{array}{r} 152.45 \\ 160.0 \\ - 75.242 \\ \hline 237.208 \end{array}$$

The correct decimal setting is:

Upper dials	0
Keyboard	3
Lower dials	3

because 3 is the greatest number of decimal places which appears in these figures.

Set these numbers on the keyboard exactly as they are written. The figures which appear to the left of the decimal point should be set to the left of the keyboard decimal marker, and those which appear to the right of the decimal should be set to the right of the keyboard decimal marker. Following the instructions for addition and subtraction, given on page 11, the result will always be correct.

### PRACTICE PROBLEMS

13.00	31.35	- 3.46
36.60	42.50	1.56
- 44.30	1.46	- 21.20
26.26	23.59	35.45
<hr/> 31.56	<hr/> 98.90	<hr/> 12.35

## MULTIPLICATION OF DECIMAL NUMBERS

Handling decimal numbers in multiplication is also very simple. As you remember from the previous instructions, to multiply on the Monroe Model LN, you set the larger number on the keyboard and, with the operating crank, turn the other number into the upper dials. When this is done, the answer appears in the lower dials.

Therefore, when multiplying decimal numbers, you should set the keyboard decimal marker to accommodate the largest number in the problem and the upper dials decimal marker to accommodate the other number. Then, following the Monroe rule for decimals, add the number of decimal places on the keyboard to the number of decimal places in the upper dials and set the lower dials decimal marker at this number of decimal places. This is exactly how you point off the decimal when multiplying by pencil and paper – add the number of decimal places in the two numbers and point off this many places in the result. All decimal markers should be set before beginning any of the work.

What is the correct decimal setting for the following example?

$$20.125 \times .425 = 8.553125$$

The larger number (20.125) will be set on the keyboard. It has three decimal places so the keyboard decimal marker should be set at 3. The other number (.425) will be entered in the upper dial, so set the upper dials decimal at 3. Add the two ( $3 + 3 = 6$ ) and set the lower dials decimal at 6. Set the decimal markers accordingly and do the example following the step by step instructions below.

<b>Method:</b>	Upper dials decimal	3	
	Keyboard decimal	3	Repeat key depressed
	Lower dials decimal	6	

**Step 1.** Set 20.125 on the keyboard (20 to the left of the keyboard decimal marker and .125 to the right).

**Step 2.** With the carriage in position "1", turn the Operating Crank 5 turns forward. Shift the carriage one place to the right. Make 2 forward turns. Shift the carriage to the right. Make 4 forward turns.

**Result:** Upper dials .425  
 Lower dials 8.553125 Answer

Note that the .425 appears in the upper dial to the right of the decimal marker and the lower dials decimal marker correctly points off the answer.

We should always set the decimal for a whole group of problems to avoid changing the decimal markers for every problem. To do this for a group of multiplication problems, simply find the largest number of decimal places appearing in the numbers to be set on the keyboard. Set the keyboard decimal marker for this number. Find the largest number of decimal places to be entered in the upper dials. Set the upper dial decimal for this number. Follow the Monroe rule and set the lower dials decimal at the sum of these two. Enter all figures around these pre-set decimals and the results will all be correct. The following example illustrates this.

$$24.75 \times .35 = 8.6625$$

$$32.5 \times .24 = 7.8$$

$$110.333 \times 1.4 = 154.4662$$

The largest number of decimal places in the numbers which go on the keyboard is 3; in numbers which go in the upper dials is 2, and therefore, the decimal setting should be:

Upper dials	2
Keyboard	3
Lower dials	5

Try the above problems and check the given answers to see if you are correct.



## DIVISION OF DECIMAL NUMBERS

In division, as explained in the instructions for simple division, both numbers, (dividend and divisor) are set on the keyboard. Therefore, when working with decimal numbers, we simply examine *all* the numbers to find the largest number of decimal places appearing in the whole group of problems at hand. Set the keyboard decimal at this number. To set the upper dials decimal always decide how many decimal places are required in the answer and set the decimal marker to one more place than this (to permit rounding off). Again, for the lower dials decimal, add the keyboard and upper dials decimal and set the lower dials decimal at this number.

**Example:**  $22.868 \div 6.7 = 3.413$  (rounded off)  
 $12.33 \div 4.25 = 2.901$  (rounded off)  
 $5.56 \div .66 = 8.424$  (rounded off)

Three is the greatest number of decimal places appearing in all the numbers in this group of problems. Set the keyboard decimal at 3. We require 3 decimal places in the answers, so set the upper dials decimal at 4 ( $3 + 1 = 4$ ). Then the lower dials decimal is 7 ( $3 + 4 = 7$ ). Step by step instructions for the first problem follows. Try the last two by yourself.

<b>Method:</b>	Upper dials	4	
	Keyboard	3	Repeat key depressed
	Lower dials	7	

*Step 1.* Set 22.868 on the keyboard. Shift the carriage so the lower dial decimal at 7 is in direct alignment with the keyboard decimal at 3. Turn the Operating Crank forward one turn. Make one forward turn of the Clear-out Crank to clear 1 from the upper dials. Depress the Keyboard Clear Key.

*Step 2.* Set 6.7 on the keyboard. Shift the carriage one place to the right. (To align the left hand digit in the lower dials with the left hand digit on the keyboard).



*Step 3.* Turn the Operating Crank backward until the bell rings. Make one forward turn. Shift the carriage one place to the left.

*Step 4.* Continue as in Step 3 until the carriage reaches the first position.

**Result:** Upper dials            3.4131 (or 3.413 rounded off)

Do the last two problems and check the answers above for accuracy.

## PRACTICE PROBLEMS

Results are rounded off to two (2) decimal places.

1.  $128.43 \div 29.5 = 4.35$

2.  $962.99 \div 37.3 = 25.82$

3.  $26.938 \div 2.45 = 11.00$

4.  $63.824 \div 5.75 = 11.10$

5.  $16.50 \div .573 = 28.80$

**Note:** Be sure to line up the lower dials decimal with the keyboard decimal before setting the first number in the lower dials.

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